

OK to enter

Amendment to the Claims

In the Claims:

Please cancel Claim 113.

No other amendments are to be made.

1. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple plates, stacked in layers, each simple plate having at least one opening that extends therethrough, an opening in each simple plate overlapping at least one other opening in an adjacent simple plate, said simple plates, when thus stacked in layers, defining:

(a) a fluid path for each different chemical reactant;

(b) a fluid path for a chemical product; and

(c) a plurality of individual reaction units providing internal parallelization of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that can be produced by said stacked plate reactor per unit time, each reaction unit including:

(i) a mixing and reaction chamber;

(ii) a reactant fluid path for each reactant, each reactant fluid path being in fluid communication with said mixing and reaction chamber; and

(iii) a bypass fluid path for each reactant, each bypass fluid path being in fluid communication with a different individual reaction unit, such that a reactant flowing in a bypass fluid path in a reaction unit does not also flow into a mixing and reaction chamber in said reaction unit.

2. (Original) The stacked plate reactor of Claim 1, further comprising at least one additional plate having no openings, said at least one additional plate being disposed to seal at least one of a top, a bottom, and a side of the stacked plate reactor

3. (Canceled)

4. (Canceled)

5. (Previously Presented) The stacked plate reactor of Claim 1, wherein a plurality of individual reaction units are irreversibly joined together to form a reactor stack.

6. (Original) The stacked plate reactor of Claim 5, wherein a plurality of individual reactor stacks are reversibly joined together to form a chemical plant.

7. (Previously Presented) The stacked plate reactor of Claim 1, further comprising means for equalizing a residence time distribution within said stacked plate reactor.

8. (Original) The stacked plate reactor of Claim 7, wherein said means for equalizing the residence time distribution within said stacked plate reactor comprises a bifurcated opening in at least one of the

1 plurality of simple plates, said bifurcated opening defining at least one of a reactant fluid path and a product
2 fluid path.

3 9. (Original) The stacked plate reactor of Claim 7, wherein said means for equalizing a residence
4 time distribution within said stacked plate reactor comprises an array of openings in at least one of the
5 plurality of simple plates, said array of openings defining at least one of a plurality of reactant fluid paths, a
6 plurality of mixing and reaction chambers, and a plurality of product fluid paths, said array of openings
7 comprising openings having widths that vary across said array.

8 10. (Original) The stacked plate reactor of Claim 9, wherein a widest opening in said array is
9 disposed furthest from an opening that enables a fluid to exit from said array.

10 11. (Original) The stacked plate reactor of Claim 9, wherein a widest opening in said array is
11 disposed closest to an opening that enables a fluid to exit from said array.

12 13. (Original) The stacked plate reactor of Claim 10, wherein the widths of said array vary as a
13 function of the change of the viscosity of a fluid to be introduced into said array.

14 15. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least
15 one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of
16 simple plates, stacked in layers, each simple plate having at least one opening that extends therethrough, an
17 opening in each simple plate overlapping at least one other opening in an adjacent simple plate, thereby
18 forming:

19 (a) a fluid path for each different chemical reactant;
20 (b) a processing volume in fluid communication with each fluid path for each different
21 chemical reactant;

22 (c) a fluid path for a chemical product in fluid communication with the processing
23 volume;

24 (d) a fluid path for a heat transfer medium;

25 (e) a heat exchanger in fluid communication with the fluid path for the heat
26 transfer medium and disposed so as to moderate a temperature of at least one of a chemical reactant,
27 the processing volume, and the fluid path for the chemical product; and

28 (f) a plurality of serially connected reaction units providing internal parallelization
29 of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that
30 can be produced by said stacked plate reactor per unit time, each reaction unit including:

31 (i) a processing volume;

32 (ii) a reactant fluid path for each reactant, each reactant fluid path being in
33 fluid communication with a processing volume; and

(iii) a bypass fluid path for each reactant in fluid communication with any subsequent reaction unit, but not in fluid communication with the processing volume of a current reaction unit.

14. (Original) The stacked plate reactor of Claim 13, further comprising at least one additional plate having no openings, said at least one additional plate being disposed to seal at least one of a top, a bottom, and a side of the stacked plate reactor.

15. (Original) The stacked plate reactor of Claim 13, wherein said simple plates comprise a material selected from the group consisting of crystalline wafers, ceramics, glasses, polymers, composite materials, and metals.

16. (Original) The stacked plate reactor of Claim 13, wherein said simple plates are fabricated from a stainless steel.

17. (Canceled)

18. (Canceled)

19. (Previously Presented) The stacked plate reactor of Claim 13, wherein each serially-connected reaction unit comprises:

- (a) a first heat exchanger for modifying a temperature of a first chemical reactant; and
- (b) a second heat exchanger for modifying a temperature of at least one of a second chemical reactant and of the processing volume.

20. (Original) The stacked plate reactor of Claim 19, wherein a heat exchanger is shared between adjacent serially-connected reaction units.

21. (Previously Presented) The stacked plate reactor of Claim 13, wherein the processing volume of each reaction unit is sandwiched between a pair of heat exchangers.

22. (Previously Presented) The stacked plate reactor of Claim 13, wherein a plurality of individual reaction units are irreversibly joined together to form a reactor stack.

23. (Previously Presented) The stacked plate reactor of Claim 13, wherein a plurality of individual reactor stacks are reversibly joined together to form a chemical plant.

24. (Previously Presented) The stacked plate reactor of Claim 13, wherein each subsequent serially-connected reaction unit is coupled to a subsequent reaction unit such that a first simple plate in a subsequent reaction unit is stacked adjacent to a last simple plate of a preceding reaction unit.

25. (Previously Presented) The stacked plate reactor of Claim 13, wherein the processing volume fluid paths for each reactant are disposed so that laminated flow is established between each reactant flowing in the processing volume.

26. (Previously Presented) The stacked plate reactor of Claim 13, wherein each subsequent serially-connected reaction unit is coupled to a subsequent reaction unit such that a first simple plate of a subsequent reaction unit also represents the last simple plate of a preceding reaction unit.

1 27. (Previously Presented) The stacked plate reactor of Claim 13, wherein the processing volume
2 fluid paths for each reactant are disposed so that laminated flow is established between each reactant
3 flowing in the processing volume.

4 28. (Previously Presented) The stacked plate reactor of Claim 13, wherein the processing volume
5 comprises a plurality of individual mixing and reaction chambers.

6 29. (Canceled)

7 30. (Canceled)

8 31. (Previously Presented) The stacked plate reactor of Claim 13, further comprising a plurality of
9 fluid channels in the heat exchanger that extend substantially orthogonal to a plurality of fluid channels for
10 directing a flow of at least one of a chemical reactant and a chemical product, where a temperature of said
11 one of the chemical product and the chemical reactant is modified by heat transfer relative to the heat
12 transfer medium that is flowing through the heat exchanger, thereby enhancing the quality of a product that
13 is produced in the stacked plate reactor.

14 32. (Previously Presented) The stacked plate reactor of Claim 13, further comprising fluid paths for
15 each chemical reactant that is disposed so as to establish laminated flow in the processing volume, thereby
16 enhancing the quality of the product that is produced in the stacked plate reactor.

17 33. (Previously Presented) The stacked plate reactor of Claim 13, further comprising a processing
18 volume simple plate disposed immediately adjacent to a simple plate having an opening defining the
19 processing volume, said processing volume simple plate having a first opening associated with a first fluid
20 path for a first chemical reagent, and a second opening associated with a second fluid path for a second
21 chemical reagent, said first opening and said second opening being aligned with the opening defining the
22 processing volume, such that a first reactant is caused to enter the processing volume, followed by a second
23 reactant in a manner that establishes laminated flow of the first reactant and the second reactant in the
24 processing volume, thereby enhancing the quality of a product that is produced in the stacked plate reactor.

25 34. (Previously Presented) The stacked plate reactor of Claim 13, further comprising means for
26 equalizing a residence time distribution of a fluid flowing within said reactor.

27 35. (Original) The stacked plate reactor of Claim 34, wherein said means for equalizing a residence
28 time distribution within said reactor comprises an opening in at least one simple plate, said opening having a
29 bifurcated shape, the bifurcated shape causing a fluid to split into a bifurcated fluid channel having a
30 plurality of branches.

31 36. (Original) The stacked plate reactor of Claim 35, wherein each chemical reactant flows through
32 a different bifurcated fluid channel, a stem of each bifurcated fluid channel being in fluid communication
33 with a respective chemical reactant inlet, and the branches of each bifurcated fluid channel being in fluid
34 communication with the processing volume.

1 37. (Original) The stacked plate reactor of Claim 35, wherein the processing volume comprises a
2 plurality of mixing and reaction chambers, such that one branch from each of the bifurcated fluid channels is
3 in fluid communication with each of the plurality of mixing and reaction chambers.

4 38. (Original) The stacked plate reactor of Claim 37, wherein the processing volume comprises a
5 plurality of mixing and reaction chambers, further comprising a bifurcated product collection channel
6 having a plurality of branches, a stem of the bifurcated product collection channel being in fluid
7 communication with a chemical product outlet, and each branch of the bifurcated product collection channel
8 being in fluid communication with a different one of the plurality of mixing and reaction chambers.

9 39. (Original) The stacked plate reactor of Claim 37, wherein a bifurcated fluid channel is included
10 for each chemical reactant and a bifurcated product collection channel is included to collect a product.

11 40. (Original) The stacked plate reactor of Claim 37, wherein the heat exchanger comprises a first
12 heat exchanger for modifying a temperature of a first chemical reactant, further comprising:

13 (a) a second heat exchanger for modifying a temperature of at least one of a second
14 chemical reactants and the processing volume;

15 (b) a third heat exchanger for modifying a temperature of at least one of the processing
16 volumes and a product collection channel; and

17 (c) a fourth heat exchanger for modifying a temperature of the product collection
18 channel.

19 41. (Original) The stacked plate reactor of Claim 34, wherein said means for equalizing a residence
20 time distribution within said reactor comprises a bifurcated fluid path having a plurality of branches.

21 42. (Original) The stacked plate reactor of Claim 41, wherein said bifurcated fluid path is achieved
22 by a bifurcated shaped opening in at least one simple plate, such that the bifurcated fluid path is oriented
23 substantially parallel to an orientation of the simple plates.

24 43. (Original) The stacked plate reactor of Claim 41, wherein said bifurcated fluid path is achieved
25 by aligning openings in a plurality of adjacent simple plates, such that the bifurcated fluid path is oriented
26 substantially orthogonally to an orientation of the simple plates.

27 44. (Original) The stacked plate reactor of Claim 41, wherein said bifurcated fluid path is achieved
28 by a combination of a bifurcated shaped opening in at least one simple plate, and by aligning openings in a
29 plurality of adjacent simple plates.

30 45. (Original) The stacked plate reactor of Claim 37, further comprising:

31 (a) a first outer simple plate having openings defining a fluid inlet for each different
32 chemical reactant, a fluid inlet for the heat transfer medium, and a fluid outlet for the heat transfer medium;
33 and

34 (b) a second outer simple plate having an opening defining the chemical product outlet.

1 46. (Original) The stacked plate reactor of Claim 37, wherein the processing volume comprises a
2 plurality of parallel mixing and reaction chambers that are disposed between a pair of heat exchangers.

3 47. (Original) The stacked plate reactor of Claim 34, wherein said means for equalizing a residence
4 time distribution of a fluid comprises a plurality of openings having different widths disposed in at least one
5 simple plate, the different widths being selected to provide a substantially even flow equipartition for a fluid
6 flowing through a plurality of different width fluid channels defined by the plurality of openings having
7 different widths.

8 48. (Canceled)

9 49. (Previously Presented) The stacked plate reactor of Claim 117, wherein a widest fluid
10 channel in said parallel array of different width fluid channels is disposed closer to a fluid inlet
11 opening than any other fluid channel in said parallel array.

12 50. (Previously Presented) The stacked plate reactor of Claim 117, wherein a widest fluid
13 channel in said parallel array of different width fluid channels is disposed further to a fluid outlet
14 opening than any other fluid channel in said parallel array.

15 51. (Previously Presented) The stacked plate reactor of Claim 117, wherein each chemical
16 reactant is directed into a different parallel array of different width fluid channels.

17 52. (Previously Presented) The stacked plate reactor of Claim 117, wherein the processing
18 volume comprises a parallel array of different width fluid channels, each different width fluid channel
19 comprising an individual mixing and reaction chamber.

20 53. (Previously Presented) The stacked plate reactor of Claim 117, wherein the widths of said
21 fluid channels in the array are determined as a function of the viscosity change of a fluid to be
22 introduced into said array.

23 54. (Previously Presented) The stacked plate reactor of Claim 117, wherein the heat exchanger
24 comprises a first heat exchanger for modifying a temperature of a first chemical reactant, and a
25 second heat exchanger for modifying a temperature of at least one of a second chemical reactant and
26 the processing volume.

27 55. (Previously Presented) The stacked plate reactor of Claim 117, further comprising one of a
28 top simple plate, a bottom simple plate, and a side simple plate, said one having openings defining a fluid
29 inlet for each different chemical reactant, a fluid inlet for the heat transfer medium, a fluid outlet for the heat
30 transfer medium, and a chemical product outlet.

31 56. (Previously Presented) The stacked plate reactor of Claim 13, further comprising a plurality of
32 elongate openings in a simple plate that define the heat exchanger, the simple plate being no thicker than
33 about two millimeters, thereby enhancing an efficiency with which the heat exchanger functions to increase
34 a quality of a product produced in said reactor.

1 57. (Original) The stacked plate reactor of Claim 13, further comprising at least one plug having a
2 size and shape corresponding to a non-required fluid path defined by aligned openings in said plurality of
3 simple plates, said at least one plug sealing the aligned openings defining said non-required fluid path,
4 thereby eliminating a dead volume in said stacked plate reactor.

5 58. (Original) The stacked plate reactor of Claim 13, wherein the stack of simple plates are
6 removably held together with an applied compressive force.

7 59. (Original) The stacked plate reactor of Claim 13, further comprising a housing that applies a
8 compressive force against a top simple plate and a bottom simple plate.

9 60. (Original) The stacked plate reactor of Claim 13, wherein a mean surface roughness of the
10 simple plates is less than about two micrometers, and the simple plates are substantially free of scratches.

11 61. (Original) The stacked plate reactor of Claim 13, wherein the simple plates are held together
12 with an applied compressive force, developing a pressure of at least about 300 Newtons per square
13 millimeter.

14 62. (Original) A simple plate chemical reactor for processing at least two reactants to form a
15 desired chemical product, comprising:
16

17 (a) a first outer simple plate comprising a fluid inlet for each different chemical
18 reactant, a fluid outlet for a chemical product, a fluid inlet for a heat transfer medium, and a fluid outlet for a
19 heat transfer medium;

20 (b) a plurality of internal simple plates defining a plurality of serially-connected reaction
21 units, each reaction unit being in fluid communication with said first outer simple plate, each reaction unit
22 comprising a stack of simple plates, stacked in layers, each simple plate having at least one opening that
23 extends therethrough, an opening in each simple plate overlapping at least one other opening in an adjacent
24 simple plate, thereby forming:

25 (i) a plurality of heat exchangers for modifying a temperature of at least one of
26 a chemical reactant and a chemical product;

27 (ii) at least one mixing and reaction chamber; and

28 (iii) a bypass fluid path for each reactant, such that a portion of each reactant is
29 diverted from the at least one mixing and reaction chamber of a present reaction unit, and is thus available to
30 be directed to at least one mixing and reaction chamber of a subsequent reaction unit; and

31 (c) a second outer plate disposed such that the plurality of internal simple plates are
32 stacked between the first outer, simple plate and the second outer plate.

1 63. (Original) A simple plate chemical reactor for processing at least two reactants to form a
2 desired chemical product, comprising:

3 (a) a first outer simple plate comprising a fluid inlet for each different chemical
4 reactant, a fluid outlet for a chemical product, a fluid inlet for a heat transfer medium, and a fluid outlet for a
5 heat transfer medium;

6 (b) a plurality of internal simple plates defining a plurality of serially-connected reaction
7 units, each reaction unit being in fluid communication with said first simple plate, each reaction unit
8 comprising a stack of simple plates, stacked in layers, each simple plate having at least one opening that
9 extends therethrough, an opening in each simple plate overlapping at least one other opening in an adjacent
simple plate, thereby forming:

10 (i) a plurality of heat exchangers for modifying a temperature of at least one of
11 a chemical reactant and a chemical product;

12 (ii) a processing volume;

13 (iii) a processing fluid path for each reactant, each processing fluid path being in
fluid communication with a corresponding reactant fluid inlet and the processing volume;

14 (iv) a product collection fluid path in fluid communication with the product
outlet and the processing volume;

15 (v) a reactant bypass fluid path for each reactant, each reactant bypass fluid
path bypassing the processing volume of a present reaction unit, and being in fluid communication
with a different reaction unit; and

16 (vi) a product bypass fluid path for the reaction product, each product
bypass fluid path bypassing the processing volume of a present reaction unit, and being in fluid
communication with a different reaction unit; and

17 (c) a second outer plate disposed such that the plurality of internal simple plates are
stacked between the first outer simple plate and the second outer plate.

18 64. (Original) The chemical reactor of Claim 63, wherein the simple plates having different
configurations are stacked to fabricate the reactor.

19 65. (Original) The chemical reactor of Claim 63, wherein said second outer plate and said first
outer simple plate are identical in configuration, further comprising a plurality of plugs to seal each opening
in said second outer plate.

20 66. (Original) The chemical reactor of Claim 65, further comprising a second simple plate disposed
between said first outer simple plate and a first reaction unit, said second simple plate having an opening
associated with a product fluid passage.

21 67. (Original) The stacked plate reactor of Claim 63, further comprising means for enhancing a
fluid distribution within said reactor.

1 68. (Original) The chemical reactor of Claim 67, wherein said means for enhancing the fluid
2 distribution within the reactor comprises an opening having a bifurcated shape formed in at least one simple
3 plate, for distributing a fluid into a bifurcated channel having a plurality of branches.

4 69. (Original) The chemical reactor of Claim 68, further comprising a bifurcated fluid channel for
5 each chemical reactant, a stem of each bifurcated fluid channel being in fluid communication with a
6 respective chemical reactant inlet, and branches of each bifurcated fluid channel being in fluid
communication with the processing volume.

7 70. (Original) The chemical reactor of Claim 68, further comprising a bifurcated product collection
8 channel having a plurality of branches, a stem of the bifurcated product collection channel being in fluid
9 communication with the chemical product outlet, and branches of said bifurcated product collection channel
10 being in fluid communication with the processing volume.

11 71. (Original) The chemical reactor of Claim 68, wherein each reaction unit includes a bifurcated
12 fluid channel and a bifurcated product collection channel.

13 72. (Original) The chemical reactor of Claim 67, wherein said means for enhancing a fluid
14 distribution within the reactor comprises at least one simple plate in which a plurality of openings having
15 different widths are formed, said different widths being selected to provide a substantially even flow
16 equipartition for a fluid flowing in a plurality of different width fluid channels defined by said plurality of
openings.

17 73. (Original) The chemical reactor of Claim 72, wherein each of the plurality of openings having
18 different widths are disposed in a parallel array, ordered in increasing widths from a narrowest opening to a
widest opening, thereby defining a parallel array of different width fluid channels.

19 74. (Original) The chemical reactor of Claim 73, wherein an incremental increase in the widths of
20 the fluid channels of said array is a function of the viscosity change of a fluid that will flow through the
21 different width fluid channels of said array, so as to equalize a residence time distribution of the fluid within
22 said array.

23 75. (Original) The chemical reactor of Claim 67, wherein said means for enhancing a fluid
24 distribution within the reactor comprises at least one simple plate in which a plurality of openings having
25 different lengths are formed, said different lengths being selected to provide a substantially equivalent even
flow equipartition for a fluid flowing in a plurality of different width fluid channels defined by said plurality
of openings.

26 76. (Previously Presented) A simple plate chemical reactor for processing at least two reactants to
27 form a desired chemical product, comprising:
28

29 (a) a first outer simple plate and a second outer simple plate, said first and second outer
30 plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a heat
transfer medium, and a fluid outlet for the heat transfer medium;

(b) a plurality of simple plates disposed between the first and the second outer simple plates, each simple plate having at least one opening that extends therethrough, an opening in each simple plate overlapping at least one other opening in an adjacent simple plate, thereby forming:

(i) a plurality of heat exchangers for modifying a temperature of at least one of a chemical reactant and a chemical product;

(ii) at least one fluid path for each chemical reactant;

(iii) at least one mixing and reaction channel; and

(iv) at least one of:

(1) at least

(1) at least one bifurcated fluid channel configured to enhance a fluid distribution within the reactor, wherein the at least one bifurcated fluid channel comprises an opening in at least one simple plate; and

(2) a plurality of openings having different widths formed in at least one simple plate, said different widths having been selected to provide a substantially even flow equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings having different widths, wherein each of the plurality of openings having different widths in a single simple plate comprise a parallel array, ordered from a narrowest opening, incrementally increasing to a widest opening, defining a parallel array of the plurality of fluid channels having different widths.

77. (Original) The simple plate chemical reactor of Claim 76, wherein the product outlet is disposed in said first outer simple plate.

78. (Original) The simple plate chemical reactor of Claim 76, wherein the product outlet is disposed in said second outer plate.

79. (Previously Presented) The simple plate chemical reactor of Claim 76, further comprising a plurality of openings in a simple plate defining a heat exchanger, and a plurality of openings in an adjacent simple plate defining at least one of a fluid path for a chemical reactant and a mixing and reaction channel, such that the plurality of openings in the simple plate defining the heat exchanger are substantially orthogonal to the plurality of openings in said adjacent simple plate.

80. (Previously Presented) The simple plate chemical reactor of Claim 76, further comprising means for enabling diffusion mixing to occur between at least a first reactant and a second reactant within the simple plate chemical reactor.

81. (Original) The simple plate chemical reactor of Claim 80, wherein said means for enabling diffusion mixing to occur comprises an upper reaction channel simple plate disposed adjacent to a simple plate having an opening defining a mixing and reaction channel, said upper reaction channel simple plate having a first opening associated with a first fluid path for a first chemical reagent, and a second opening associated with a second fluid path for a second chemical reagent, said first opening and said second opening being aligned with the opening defining a mixing and reaction channel, such that a first reactant is

1 caused to enter the mixing and reaction channel first, followed by a second reactant, establishing laminated
2 flow between the first reactant and the second reactant in the mixing and reactant channel.

3 82. (Canceled)

4 83. (Canceled)

5 84. (Previously Presented) The simple plate chemical reactor of Claim 76, wherein the at least one
6 bifurcated fluid channel comprises a different bifurcated fluid channel for each chemical reactant, each
7 different bifurcated fluid channel having a stem and a plurality of branches, the stem of each bifurcated fluid
8 channel being in fluid communication with a respective chemical reactant inlet, and branches of each
bifurcated fluid channel being in fluid communication with a mixing and reaction channel.

9 85. (Previously Presented) The simple plate chemical reactor of Claim 76, wherein the at least one
10 bifurcated fluid channel comprises a bifurcated product collection channel, the stem of the bifurcated
11 product collection channel being in fluid communication with the product outlet, and the branches of said
bifurcated product collection channel being in fluid communication with a mixing and reaction channel.

12 86. (Previously Presented) The simple plate chemical reactor of Claim 76, wherein a bifurcated
13 fluid channel is included for each chemical reactant and one bifurcated fluid channel comprises a bifurcated
14 product collection channel.

15 87. (Previously Presented) The simple plate chemical reactor of Claim 76, wherein said plurality of
16 heat exchangers comprise:

17 (a) a first heat exchanger for modifying a temperature of a first chemical reactant;

18 (b) a second heat exchanger for modifying a temperature of at least one of a second
chemical reactant and a mixing and reaction channel;

19 (c) a third heat exchanger for modifying a temperature of at least one of said mixing
and reaction channel and a product collection channel; and

20 (d) a fourth heat exchanger for modifying a temperature of said product collection
channel.

23 88. (Canceled)

24 89. (Canceled)

25 90. (Previously Presented) The simple plate chemical reactor of Claim 76, wherein a widest fluid
channel in said parallel array of fluid channels is disposed further to a fluid outlet opening than any other
fluid channel in said parallel array.

27 91. (Original) The simple plate chemical reactor of Claim 90, wherein each chemical reactant is
28 directed into a different parallel array of fluid channels having different widths, each different parallel array
29 of fluid channels being disposed in a different simple plate.

30 92. (Original) The simple plate chemical reactor of Claim 90, wherein the parallel array of fluid
channels having different widths comprises a mixing and reaction channel.

1 93. (Canceled)

2 94. (Previously Presented) The simple plate chemical reactor of Claim 76, further comprising
3 means for providing internal parallelization of said simple plate chemical reactor, to achieve increased
4 throughput.

5 95. (Original) The simple plate chemical reactor of Claim 94, wherein contiguous sets of the
6 simple plates comprise a plurality of serially-connected reaction units, and wherein said means for providing
7 internal parallelization comprise a plurality of openings in different contiguous sets of the simple plates,
which when aligned form, for each one of said serially-connected reaction units:

8 (a) a reaction unit fluid path in fluid communication with processing volumes in that
9 reaction unit; and

10 (b) a bypass fluid path that bypasses all processing volumes in that reaction unit, and is
11 in fluid communication with any subsequent reaction unit.

12 96. (Original) The simple plate chemical reactor of Claim 95, wherein each serially-connected
reaction unit comprises:

13 (a) a first heat exchanger for modifying a temperature of a first chemical reactant;

14 (b) a second heat exchanger for modifying a temperature of at least one of a second
15 chemical reactant and a mixing and reaction channel, said mixing and reaction channel being operative to:

16 (i) establish a laminated flow between a first chemical reactant and a second
chemical reactant;

17 (ii) mix the first chemical reactant and the second chemical reactant together via
diffusion mixing; and

18 (iii) provide sufficient residence time for initiating a chemical reaction between
the first chemical reactant and the second chemical reactant; and

19 (c) a third heat exchanger for modifying a temperature of said mixing and reaction
channel.

20 97. (Original) The simple plate chemical reactor of Claim 96, wherein the first heat exchanger of
each serially-connected reaction unit disposed downstream of a different serially-connected reaction unit
also comprises the third heat exchanger of the reaction unit disposed immediately upstream.

21 98. (Original) The simple plate chemical reactor of Claim 95, wherein a plurality of said
22 serially-connected reaction units are irreversibly joined together to form a reactor stack.

23 99. (Original) The simple plate chemical reactor of Claim 98 wherein a plurality of individual
24 reactor stacks are reversibly joined together to form a chemical plant.

25 Claims 100 - 110 (Canceled)

26 111. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least
one other chemical reactant to form a chemical product, said stacked plate reactor comprising:

(a) a plurality of simple plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

- (i) a fluid path for each different chemical reactant;
 - (ii) a fluid path for a chemical product;
 - (iii) a fluid path for a heat transfer medium;
 - (iv) a heat exchanger coupled in fluid communication with the fluid path for
um; and
 - (v) means for manipulating a flow of fluid in said stacked plate reactor to
lt; and

(b) at least one additional plate having no openings, said at least one additional plate being disposed to seal at least one of a top, a bottom, and a side of the stacked plate reactor.

112. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby defining:

- (a) a fluid path for each different chemical reactant;
 - (b) a fluid path for a chemical product;
 - (c) a fluid path for a heat transfer medium;
 - (d) a heat exchanger coupled in fluid communication with the fluid path for the heat transfer medium; and

(e) means for providing internal parallelization of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that can be produced by said stacked plate reactor per unit time, such internal parallelization being characterized by achieving at least two parallel fluid flows in different layers of the stacked plate reactor that are not in fluid communication with each other.

113. (Currently Canceled)

114. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby defining:

- (a) a fluid path for each different chemical reactant;

- (b) a processing volume in fluid communication with each fluid path for each different chemical reactant;
 - (c) a fluid path for a chemical product in fluid communication with the processing volume;
 - (d) a fluid path for a heat transfer medium; and
 - (e) a heat exchanger in fluid communication with the fluid path for the heat transfer medium and disposed so as to moderate a temperature of at least one of a chemical reactant, the processing volume, and the fluid path for the chemical product, the heat exchanger comprising a plurality of heat exchanger fluid channels that extend substantially orthogonal to a plurality of fluid channels for directing a flow of at least one of a chemical reactant and a chemical product, such that the plurality of heat exchanger fluid channels are not in fluid communication with the plurality of fluid channels for directing a flow of at least one of the chemical reactant and the chemical product, and where a temperature of said one of the chemical product and the chemical reactant is modified by heat transfer relative to the heat transfer medium that is flowing through the heat exchanger.

115. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

- (a) a fluid path for each different chemical reactant;
 - (b) a first reaction unit defined by a plurality of openings in the simple plates, said plurality of openings being aligned to form, for each different chemical reactant:
 - (i) a reaction unit fluid path in fluid communication with a processing volume in said first reaction unit; and
 - (ii) a bypass fluid path that bypasses the processing volume in the first reaction unit and is in fluid communication with any subsequent reaction unit; and
 - (c) a last reaction unit defined by the plurality of openings in the simple plate, said plurality of openings being aligned to form, for each different chemical reactant, a reaction unit fluid path in fluid communication with a processing volume in said last reaction unit;
 - (d) a fluid path for a chemical product in fluid communication with each processing volume;
 - (e) a fluid path for a heat transfer medium; and
 - (f) a heat exchanger in fluid communication with the fluid path for the heat transfer medium and disposed so as to moderate a temperature of at least one of a chemical reactant, at least one processing volume, and the fluid path for the chemical product.

1 116. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least
2 one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of
3 simple plates, stacked in layers, each simple plate having a plurality of openings that extend
4 therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked
5 plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby defining:

- 6 (a) a single fluid inlet for each chemical reactant;
- 7 (b) a reactor fluid path for each chemical reactant, each reactor fluid path being in fluid
communication with a processing volume in a first reaction unit;
- 8 (c) a bypass fluid path for each chemical reactant, each bypass fluid path
bypassing the processing volume in the first reaction unit, and being in fluid communication with any
9 subsequent reaction unit; and
- 10 (d) a single fluid outlet for the chemical product.

11 117. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least
12 one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of
13 simple plates, stacked in layers, each simple plate having a plurality of openings that extend
14 therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked
15 plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

- 16 (a) a fluid path for each different chemical reactant;
- 17 (b) a processing volume in fluid communication with each fluid path for each different
chemical reactant;
- 18 (c) a fluid path for a chemical product in fluid communication with the processing
volume;
- 19 (d) a plurality of openings having different widths disposed in at least one simple plate,
the different widths being selected to provide a substantially even flow equipartition for a fluid flowing
20 through a plurality of different width fluid channels defined by the plurality of openings having different
widths, wherein each of the plurality of openings having different widths are disposed in a parallel array,
21 said openings being ordered so as to decrease in size from a widest opening to a narrowest opening and
defining a parallel array of the different width fluid channels;
- 22 (e) a fluid path for a heat transfer medium; and
- 23 (f) a heat exchanger in fluid communication with the fluid path for the heat transfer
medium and disposed so as to moderate a temperature of at least one of a chemical reactant, at least one
24 processing volume, and the fluid path for the chemical product.

25 118. (Previously Presented) A simple plate chemical reactor for processing at least two reactants to
26 form a desired chemical product, comprising:

(a) a first outer simple plate and a second outer simple plate, said first and second outer simple plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a heat transfer medium, and a fluid outlet for the heat transfer medium; and

(b) a plurality of simple plates disposed between the first and the second outer simple plates, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers, openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

(i) a plurality of heat exchangers for modifying a temperature of at least one of a chemical reactant and a chemical product;

(ii) at least one fluid path for each chemical reactant;

(iii) at least one mixing and reaction channel; and

(iv) at least one bifurcated fluid channel co

distribution within the reactor.

119. (Previously Presented) A simple plate chemical reactor for processing at least two reactants to form a desired chemical product, comprising:

(a) a first outer simple plate and a second outer simple plate, said first and second outer simple plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a heat transfer medium, and a fluid outlet for the heat transfer medium; and

(b) a plurality of simple plates disposed between the first and the second outer simple plates, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers, openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

(i) a plurality of heat exchangers for modifying a temperature of at least one of a chemical reactant and a chemical product;

(ii) at least one fluid path for each chemical reactant;

(iii) at least one mixing and reaction channel; and

(iv) a plurality of openings having different widths formed in at least one simple plate, said different widths having been selected to provide a substantially even flow equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings having different widths.

120. (Previously Presented) A simple plate chemical reactor for processing at least two reactants to form a desired chemical product, comprising:

(a) a first outer simple plate and a second outer simple plate, said first and second outer simple plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a heat transfer medium, and a fluid outlet for the heat transfer medium; and

(b) a plurality of simple plates disposed between the first and the second outer simple plates, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers, openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

(i) a plurality of heat exchangers for modifying a temperature of at least one of a chemical reactant and a chemical product;

(ii) at least one fluid path for each chemical reactant;

(iii) at least one mixing and reaction channel; and

(iv) a plurality of openings having different lengths formed in at least one different lengths having been selected to provide a substantially even flow fluid flowing in a plurality of fluid channels defined by the plurality of openings h.

121. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple plates stacked in layers, each simple plate having a plurality of openings that extend therethrough, openings in each simple plate overlapping openings in an adjacent simple plate, thereby forming:

(a) a fluid path for each different chemical reactant;

(b) a fluid path for a chemical product; and

(c) at least one of:

(i) at least one bifurcated fluid channel configured to enhance a fluid distribution within the reactor;

(ii) a plurality of openings having different widths formed in at least one simple plate, said different widths having been selected to provide a substantially even flow equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings having different widths;

(iii) a plurality of openings having different lengths formed in at least one simple plate, said different lengths having been selected to provide a substantially even flow equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings having different lengths; and

(iv) a plurality of individual reaction units providing internal parallelization of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that can be produced by said stacked plate reactor per unit time, each reaction unit including:

(1) a mixing and reaction chamber;

(2) a reactant fluid path for each reactant, each reactant fluid path being in fluid communication with said mixing and reaction chamber; and

(3) a bypass fluid path for each reactant, each bypass fluid path being in fluid communication with a different individual reaction unit, such that a reactant flowing in a bypass fluid path in a reaction unit does not also flow into a mixing and reaction chamber in said reaction unit.

122. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor being assembled from a plurality of plates stacked in layers, said stacked plate reactor comprising:

- (a) a fluid path for each different chemical reactant;
 - (b) a fluid path for a chemical product; and
 - (c) at least one of:

(i) at least one bifurcated fluid channel configured to enhance a fluid distribution within the reactor;

(ii) a plurality of openings having different widths formed in at least one simple plate, said different widths having been selected to provide a substantially even flow equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings having different widths;

(iii) a plurality of openings having different lengths formed in at least one simple plate, said different lengths having been selected to provide a substantially even flow equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings having different lengths; and

(iv) a plurality of individual reaction units providing internal parallelization of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that can be produced by said stacked plate reactor per unit time, each reaction unit including:

- (1) a mixing and reaction chamber;

(2) a reactant fluid path for each reactant, each reactant fluid path being in fluid communication with said mixing and reaction chamber; and

(3) a bypass fluid path for each reactant, each bypass fluid path being in fluid communication with a different individual reaction unit, such that a reactant flowing in a bypass fluid path in a reaction unit does not also flow into a mixing and reaction chamber in said reaction unit.

123. (Previously Presented) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple plates stacked in layers, each simple plate having a plurality of openings that extend

1 therethrough, openings in each simple plate overlapping openings in an adjacent simple plate, thereby
2 forming:

3 (a) a fluid path for each different chemical reactant;

4 (b) a fluid path for a chemical product; and

5 (c) a heat transfer fluid path for a heat transfer medium, such that the heat transfer fluid
6 path and the fluid paths for each different chemical reactant and the chemical product are not in fluid
communication;

7 (d) a heat exchanger coupled in fluid communication with the fluid path for the
8 heat transfer medium; and

9 (e) means for manipulating a flow of fluid in said stacked plate reactor to achieve
10 a desired result.

11 a heat transfer fluid path for a heat transfer medium, such that the heat transfer fluid path and the
12 fluid paths for each different chemical reactant and the chemical product are not in fluid communication

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30